

# Description

## [FAN MODULE]

### BACKGROUND OF INVENTION

[0001] Field of the Invention

[0002] The present invention relates to a fan module. More particularly, the present invention relates to a fan module that can be mounted inside a portable device for carrying hot air away from the interior of the portable device.

[0003] Description of Related Art

[0004] With rapid progress in computer technologies, the operating speed of computers continues to increase. Because many of the electronic devices within the host computer produce heat, a cooling system must be installed to expel the heat and prevent any temporary or permanent damage to the devices due to overheating. Aside from the power supply, the central processing unit (CPU), the graphic processing unit (GPU) and the chipset, an additional fan module is often installed inside the host computer to remove the heat generated by operating electronic devices so that

the computer can operate smoothly. It should be noted that notebook computer with a small interior space are more vulnerable to damage because of the rapid heating of air within a small confined space. Hence, a fan module is frequently installed inside a notebook computer for expelling hot air from the interior of the computer.

[0005] Fig. 1 is a perspective view of a conventional fan module. The fan module 100 as shown in Fig. 1 is often used inside a notebook computer. The fan module 100 mainly comprises a casing 110 and a fan 120. The casing 110 has a mounting space 112, an air inlet 114 and an air outlet 116. The air inlet 114 and the air outlet 116 are linked to the mounting space 112 so that air is able to pass from the air inlet 114 to the air outlet 116 via the mounting space 112. The fan 120 is set up within the mounting space 112. When the fan 120 inside the fan module 100 is rotating, air enters the casing 110 from the air inlet 114 and then exhaust via the air outlet 116. If the fan module 110 is installed inside a notebook computer, hot air within the computer produced by the interior electronic devices will be drawn away. Thus, the notebook computer is cooled to provide a smooth operation.

[0006] In the conventional setup, no grating is set up across the

entrance area of the air outlet 116 of the fan module 100. Thus, a conductive object (for example, a paper clip or a staple) having an outer diameter smaller than the air inlet 114 and the air outlet 116 can easily slip into a notebook computer via the air outlet 116, the mounting space 112 and the air inlet 114. When the conductive object happens to contact any electric contact or circuit inside the notebook computer, the notebook computer may malfunction. To reduce the possibility of small conductive object from getting into the interior of the notebook computer, the current regulation for portable device demands any slots on the surface of the casing having a direct linkage with the interior must have a minimum width not exceeding 1mm.

## **SUMMARY OF INVENTION**

[0007] Accordingly, the present invention is directed to a fan module that can be mounted within a portable device capable of carrying hot air away from the interior to the exterior of the portable device.

[0008] According to an embodiment of the present invention, the fan module comprises a casing, a fan and a plurality of fins. The casing has a mounting space, an air inlet and an air outlet. The air inlet and the air outlet are linked to-

gether via the mounting space. The fan is installed inside the mounting space. The fins are disposed across the air outlet with each fins aligned in parallel to each other. The fins have a plurality of protruding sections protruding from a surface of the fins. Neighboring fins are separated from each other through the protruding sections so that the fins altogether divide the air outlet into a plurality of slots whose width is less than or equal to 1mm.

[0009] The fan module of the present invention utilizes a plurality of parallel-aligned fins with each pair of neighboring fins separated from each other through the protruding sections to provide a plurality of slots each having a width smaller than or equal to 1mm across the air outlet of the casing. Width of the slots is also maintained through the protruding sections on the fins. Therefore, after installing the fan module inside a portable device, the fan module can easily remove hot air from the interior to the exterior of the portable device. Furthermore, the parallel-aligned fins also prevent any small conductive objects from entering the casing through the air outlet so that at least the minimum safety regulation of a portable device is met.

[0010] It is to be understood that both the foregoing general description and the following detailed description are exem-

plary, and are intended to provide further explanation of the invention as claimed.

## **BRIEF DESCRIPTION OF DRAWINGS**

[0011] The accompanying drawings are included to provide a further understanding of the invention, and are incorporated in and constitute a part of this specification. The drawings illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

[0012] Fig. 1 is a perspective view of a conventional fan module.

[0013] Fig. 2A is a perspective view of a fan module according to one embodiment of the present invention.

[0014] Fig. 2B is a perspective view showing the major components of a fan module according to one embodiment of the present invention.

[0015] Fig. 3A is a perspective view showing the structure after one type of fins according to one embodiment of the present are stacked together.

[0016] Fig. 3B is a perspective view showing the structure after another type of fins according to one embodiment of the present are stacked together.

## **DETAILED DESCRIPTION**

[0017] Reference will now be made in detail to the present preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers are used in the drawings and the description to refer to the same or like parts.

[0018] Fig. 2A is a perspective view of a fan module according to one embodiment of the present invention. Fig. 2B is a perspective view showing the major components of a fan module according to one embodiment of the present invention. As shown in Figs. 2A and 2B, the fan module 200 mainly comprises a casing 210, a fan 220 and a plurality of fins 230. The casing 210 has a mounting space 212, an air inlet 214 and an air outlet 216. The air inlet 214 and the air outlet 216 are linked together through the mounting space 212. Furthermore, the casing 210 further comprises a cover plate 210a and a base 214a. The air inlet 214 is formed, for example, by hollowing out a portion of the cover plate 210a. Moreover, a portion of the side body of the cover plate 210a and a portion of the side body of the base 210b together form the air outlet 216. The fins 230 are connected to the bottom surface of the cover plate 210a. The fan 220 is installed inside the mounting

space 212.

[0019] When the fan 220 rotates, air enters the fan module 200 from the air inlet 214, moves into the mounting space 212 and then exhausts from the mounting space 212 through the air outlet 216. In practice, the fan module 200 can be disposed inside any portable devices (for example, a portable computer: a notebook computer or a tablet computer). The air outlet 216 of the fan module 200 is exposed to the exterior of the portable device so that any hot air accumulated within the device can be carried away from the interior through the fan module 200.

[0020] To meet the safety regulation of a portable device, the fins 230 are disposed across the interior of the air outlet 216. The fins 230 are aligned in parallel to partition the air outlet 216 into a plurality of long narrow slots 216a. The separation between neighboring fins 230 across the air outlet 216 is adjusted so that each slot 216a has a width smaller than or equal to 1mm for meeting the minimum safety regulation. It should be noted that the width of each slot 216a is preferably set between 0.8 to 1mm. The fins 230 are laid in a direction (the Z-axis in Fig. 2A) perpendicular to the length (the Y-axis in Fig. 2A) of the air outlet 216. In other words, the fins 230 are laid in a direc-

tion parallel to the length of the air outlet 216.

[0021] When a portable device having a fan module 200 according to the present invention is carried around or moved, small conductive objects (for example, a metallic clip or staple) are prevented by the fins 230 from getting into the device through the air outlet 216. Therefore, when the fan module 200 according to the present embodiment is installed inside a portable device with the air outlet 216 exposed by the casing 210, the fins 230 across the air outlet 216 is an effective barrier stopping any small conductive objects from getting into the portable device.

[0022] To maintain a width smaller than 1mm and provide sufficient strength to resist distortion due to impact or collision, the slots 216a must be reinforced. Fig. 3A is a perspective view showing the structure after one type of fins according to one embodiment of the present are stacked together. As shown in Fig. 3A, each fin 230 are shaped into a longitudinal strip having first protruding sections 232 protruding from an upper surface 230a and each end or the middle of the fin 230. Furthermore, the first protruding sections 232 are attached, for example, by welding to a bottom surface 230b of an upper fin 230. Hence, a constant width is maintained along the length of each



slot 216a bounded by an upper and a lower fins 230.

[0023] It should be noted that the first protruding sections 232 on the fins 230 can be fabricated by a mechanical punching process if the aim is to reduce material cost and processing time. The punching process saves time and cost because a single stroke is able to cut and bend up a portion of the material to form the first protruding sections 232. In other words, the first protruding sections 232 are formed by cutting the fin 230 up and bending the uncut portion.

[0024] As shown in Figs. 2A and 3A, the inner wall of the air outlet 216 also separates from the nearest fin 230 through these first protruding sections 232 to form a slot 216a.

[0025] Fig. 3B is a perspective view showing the structure after another type of fins according to one embodiment of the present are stacked together. Aside from having a plurality of first protruding sections 232 on the fins as shown in Fig. 3A, the fins 230 in Fig. 3B further includes a plurality of second protruding sections 234 thereon. The second protruding sections 234 protrude from a bottom surface 230b of the fins 230. Similarly, the second protruding sections 234 are attached, for example, by welding to an underlying fin 230. Hence, a constant width is maintained

along the length of each slot 216a bounded by upper and lower fins 230.

[0026] Similarly, the second protruding sections 234 on the fins 230 can be fabricated by a mechanical punching process to reduce material cost and processing time. The punching process saves time and cost because a single stroke is able to cut and bend down a portion of the material to form the second protruding sections 234. In other words, the second protruding sections 234 are formed by cutting the fin 230 up and bending the uncut portion thereafter. In the present embodiment, the first protruding section 232 and pair of second protruding section 234 at each end of the fin 230 may be fabricated together. Furthermore, the first protruding section 232 and the pair of second protruding sections 234 on neighboring fins can be clamped together to form a junction interface for joining with the inner wall of the casing 210.

[0027] As shown in Figs. 2A and 3B, the inner wall of the air outlet 216 also separates from the nearest fin 230 through these second protruding sections 234 to form a slot 216a.

[0028] In summary, the fan module of the present invention utilizes a plurality of parallel-aligned fins with each pair of neighboring fins separated from each other through the

protruding sections to provide a plurality of slots each having a width smaller than or equal to 1mm across the air outlet of the casing. Therefore, after installing the fan module inside a portable device, the fan module is capable of removing hot air from the interior and exhaust to the exterior of the portable device. Furthermore, the parallel-aligned fins also prevent any small conductive objects from entering the casing through the air outlet so that at least the minimum safety regulation of a portable device is met. In addition, the fan module of the present invention can be applied to a portable device other than a notebook computer such as a tablet computer.

[0029] It will be apparent to those skilled in the art that various modifications and variations can be made to the structure of the present invention without departing from the scope or spirit of the invention. In view of the foregoing, it is intended that the present invention cover modifications and variations of this invention provided they fall within the scope of the following claims and their equivalents.